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ABSTRACT

Maintaining order and preventing chaos in the classroom are major concerns of educators. However, for many teachers these concerns create a motivational dilemma. If a class lacks order, students tend to play and become over-excited instead of learning. On the other hand, if a class is strictly ordered, students become bored and make minimal effort for learning. Whether the class is ordered, or lacks order, the results for achievement motivation are detrimental. Strict order leads to apathetic stagnation and the lack of order leads to chaotic over-excitement. This paper proposes that the resolution of this dilemma is found dancing on the "edge of chaos" where a dynamical system of motivation emerges. This system unites both the serious and fun aspects of motivation into a complex order. This new order is called "serious fun" and is defined as "play with a purpose." Serious fun goes beyond the apathy of strict order and the over-excitement of chaos to generate an ordered chaos that permits freedom within structure and fun within limits. In this paper, the motivational dilemma concerning chaos in the classroom is elaborated and analyzes, and then the proposed resolution of this dilemma, serious fun, is conceptualized by the introduction of contemporary theories of dynamical systems and psychological reversals. Finally, general educational recommendations on how to dance on the edge of chaos and motivate students with serious fun are provided. (Contains 40 references.) (Author)

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Achievement Motivation as a Dynamical System: Dancing on the "Edge of Chaos" with "Serious Fun"

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Abstract

Maintaining order and preventing chaos in the classroom are major concerns of educators. However, for many teachers these concerns create a motivational dilemma. If a class lacks order, students tend to play and become over-excited instead of learning. On the other hand, if a class is strictly ordered, students become bored and make minimal effort for learning. Whether the class is ordered or lacks order, the results for achievement motivation are detrimental. Strict order leads to apathetic stagnation and the lack of order leads to chaotic over-excitement.
This paper proposes that the resolution of this dilemma is found dancing on the "edge of chaos" where a dynamical system of motivation emerges. This system unites both the serious and fun aspects of motivation into a complex order. This new order is called "serious fun" and is defined as "play with a purpose." Serious fun goes beyond the apathy of strict order and the over-excitement of chaos to generate an ordered chaos that permits freedom within structure and fun within limits.

In this paper, the motivational dilemma concerning chaos in the classroom is elaborated and analyzed, and then the proposed resolution of this dilemma, serious fun, is conceptualized by the introduction of contemporary theories of dynamical systems and psychological reversals. Finally, general educational recommendations on how to dance on the edge of chaos and motivate students with serious fun are provided.

Achievement Motivation as a Dynamical System: Dancing on the "Edge of Chaos" with "Serious Fun"

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Among educators' major concerns are maintaining order and preventing chaos in the classroom. The concern with chaos apparently stems from a fear of losing control and the unpredictable outcome of chaos (Rea, 1995). For many teachers this fear of losing control and the ensuing chaos results in a motivational dilemma (Rea, 1995). On the one hand, these teachers are afraid to motivate students with openly fun activities because the high stimulation can result in the chaos of over-excitement. On the other hand, strictly ordered lessons tend to be deadly serious and typically lead to boredom and apathy. Both alternatives are detrimental to motivation and learning. Teachers are faced with a motivational dilemma of either a strictly ordered class with boring seriousness or a totally chaotic class with unbridled fun. The proposed resolution of this dilemma is found dancing on the "edge of chaos" (Lewin, 1992; Waldrop, 1992) where a dynamical system of motivation emerges. This system unites both the serious and fun aspects of motivation into a complex order. This new order of motivation is called "serious fun" and is defined as "play with a purpose" (Rea, 1993, 1995). Serious fun goes beyond the apathy of strict order and the over-excitement of chaos to generate a complex order (ordered chaos) that permits freedom within structure and fun within limits.

The primary goals of this article are to analyze the motivational dilemma concerning chaos in the classroom and to provide a creative resolution with the conceptualization of achievement motivation as a dynamical system of "serious fun." The secondary goals are to teach educators how to dance on the edge of chaos and to motivate students with serious fun. Traditionally, theories of achievement motivation have neglected the unpredictable emergence of spontaneous fun and favored a more predictable view of motivation as the conscious exertion of serious effort toward a preset goal (Good & Brophy, 1994, p. 212; Vallacher & Nowak, p. 11, 1994). Achievement motivation as serious fun redresses this neglect and puts the fun back in motivation.

In the next sections, the motivational dilemma of strict order versus total chaos is elaborated and analyzed, and then the proposed resolution of this dilemma, serious fun, is conceptualized by the

introduction of contemporary theories of dynamical systems (Doll, 1993; Gleick, 1987; Hayles, 1990) and psychological reversals (Apter, 1982, 1989). Finally, general educational recommendations on how to dance on the edge of chaos with serious fun are provided.

DESCRIPTION OF CHAOTIC VERSUS STRICTLY ORDERED CLASSES

Chaotic classes are typically characterized by loud noise, unrestricted movement, and frivolous social interaction. In these classes, students play and become wildly excited instead of learning, and if left uncontrolled this over-excitement can lead to disorderly conduct (Rea, 1995). Teachers who allow this chaotic activity are generally labelled permissive. These teachers may like students but they lack the direction and structure necessary for seriously motivating learning.

On the other hand, many teachers prefer strictly ordered classes where they are in control and the outcomes are highly predictable. These classes are characterized by the absence of student noise, movement, or social interaction. The typical example is the class where students sit in assigned seats in straight rolls, silently doing individual seat work or attentively taking notes from a teacher's lecture. The teacher directs and structures student learning with preestablished, highly defined routines, schedules, rules, and objectives (Rea, 1995). The teacher also strictly supervises students' work and keeps them on task and on schedule. Furthermore, the teacher closely monitors students' behavior and immediately corrects or eliminates all distractions and disorderly behavior.

The shortcomings of the chaotic classroom, lack of serious motivation and disorderly behavior, are readily apparent but the motivational limitations of the strictly ordered classroom are sometimes overlooked. Students tend to become bored and apathetic with the preset routine or excessively worried about the strict accountability. As a result, many students make minimal efforts because they are bored/apathetic or they become overly preoccupied with the appearance of looking smart or at least not looking stupid (Ames, 1992; Dweck, 1986), and some become disorderly as they rebel against the strict control. In each of these cases, the motivational joy of learning is missing or critically jeopardized.

MOTIVATIONAL DILEMMA AND PROPOSED RESOLUTION

Teachers in these two contrasting classes appear to be faced with a motivational dilemma concerning order in the class (Rea, 1995). If a class lacks order, students tend to play and become over-excited instead of learning. On the other hand, if a class is strictly ordered, students become bored/apathetic and make minimal effort for learning. Whether the class is ordered or lacks order, the results for achievement motivation are detrimental. Strict order leads to apathetic stagnation and the lack of order leads to chaotic over-excitement.

The resolution of this dilemma comes from realizing there is a viable alternative to these two extremes. This alternative is found dancing on the "edge of chaos" where dynamical systems emerge with a higher level of complexity (Lewin, 1992; Waldrop, 1992). This alternative reconceptualizes the motivation of individuals, classes, and schools as a complex order. The motivation of this complex order takes educators beyond the impoverished choice of either the unbridled excitement of chaos or the stagnant apathy of strict order. Furthermore, this new system of order is not reducible to a moderate amount of order nor is it restricted to the intermediate zone of a linear continuum. Rather, it is a nonlinear departure from this linear continuum that precipitates a new level of self-organization. The mutual interaction of both order and chaos are necessary for the emergence of this more sophisticated level of organization. Hence, chaos need not be dreaded by teachers and administrators. Quite to the contrary, chaos generates the spark of excitement essential for motivation. However, it can only be effectively harnessed if teachers and administrators learn how to dance on the precarious edge of chaos where the surprise of the unexpected continually challenges and delights all those involved.

Kauffman (1991, p. 82) states that Langton, a computer scientist at Los Alamos national Laboratory, has likened the edge of chaos to the phase transition of liquids that emerge between the ordered state of cold solids and the chaotic state of hot gases. The edge of chaos is an ever shifting fluid state where "Interesting dynamic behaviors emerge..." (Kauffman,1991, p. 82). It is the "...one place where a complex system can be spontaneous, adaptive, and alive" (Waldrop, 1993, p. 12). At the edge of chaos this intermediate fluid state is able to adapt to complex change while the highly ordered state is too frozen to accommodate complex change and the chaotic state is too disordered to coordinate complex change (Kauffman, 1991, p. 82).

MOTIVATION AS SERIOUS FUN

In the following sections achievement motivation is more fully conceptualized as a dynamical system. Building on this conceptualization, reversal theory (Apter, 1982, 1989; Rea, 1993, 1995) is used to more specifically construct a dynamical system of motivation called "serious fun." Derived from reversal theory, serious fun is defined as fun with a purpose (Rea, 1993,1995) and is portrayed as a strange attractor that optimizes motivation. Serious fun provides the ideal motivation for learning and adapting in a constantly changing world (Mann, 1996; Rathunde, 1993). It is a strange attractor that emerges at the edge of chaos as a fluid state of focused motivation. This optimal motivation is often experienced as a sense of "flowing" (Csikszentmihalyi & Csikszentmihalyi,1990; Mannell, Zuzanek, & Larson, 1988; Rea, 1993). When students experience flow, they become so absorbed in a task that time seems to fly by and effort flows effortlessly.

When seriousness and fun are isolated from each other, motivational problems occur. Teachers who are deadly serious demand a "cold" rigid order in the class that results in apathy and boredom. In this "cold" classroom, time drags on as students make minimal efforts to do their assignments. Teachers who are totally fun allow a "hot" chaotic disorder in the class that invites disruptive over-excitement. In this "hot" classroom, students attempt to pass time with frivolous amusements that subvert learning. Serious fun is proposed as a viable alternative to the motivational dilemma of stagnant order versus chaotic disorder.

To the serious teacher with a strictly ordered class, the strangeness of serious fun is threatening. This teacher confuses the productive noise of serious fun with the nonproductive noise of over-excitement. Hopefully, this article will provide a conceptual framework for validating and distinguishing productive noise from nonproductive noise as well as offer practical recommendations for optimizing motivation with serious fun. The intent is to show how serious fun is strangely fascinating instead of threatening or confusing. To set the stage for this analysis and exploration, the key characteristics of dynamical systems will first be introduced, explained, and illustrated with educational examples.

KEY CHARACTERISTICS OF DYNAMICAL SYSTEMS

The study of dynamical systems is primarily concerned with how a

system's variables interact, change, and evolve over time (Gleick, 1987). Applied to psychology, these systems focus on how psychological states (motivation, learning, mood, attitude, etc.) interact, change, and evolve over time (Abraham, Abraham, & Shaw, 1990; Barton, 1994; Eiser, 1994; Vallacher & Nowak, 1994). They are commonly identified with a philosophy of becoming rather than being (Prigogine & Stengers, 1984). The emphasis is on a system's process of becoming rather than its static properties of being. In this article motivation is portrayed as a dynamical process of becoming that evolves over time.

Nonlinear Change

A distinctive characteristic of a dynamical system is nonlinear change (Chieuw, 1991; Hayles, 1990). A system may exhibit nonlinear change as disproportionate change, circular change, or emergent change. Disproportionate change means that a small change can lead to a large change as in the straw that broke the camel's back. In contrast, proportionate change occurs when a small change merely leads to another small change in a gradual incremental manner. Circular change means that change feeds back into itself in a recursive manner as opposed to the direct change of one billiard ball striking another ball. Emergent change means that simple changes can result in complex changes, whereas nonemergent changes are simple changes that merely result in simple changes or complex changes that result in complex changes. In this article optimal motivation is characterized as a dynamical process that emerges in complex unexpected ways.

Near-Equilibrium Systems

Dynamical systems can be described as either *near-equilibrium* or *far-from-equilibrium* (Chieuw, 1991). This article argues that optimal motivation is a far-from-equilibrium system capable of facilitating complex change. However, motivation has traditionally been portrayed as a near-equilibrium system that primarily controls linear change. Systems that are near equilibrium are closed systems predominantly governed by negative feedback (Chieuw, 1991). In near-equilibrium systems all deviations or fluctuations from equilibrium are counteracted by *negative feedback* loops. The primary goal of this system is to maintain equilibrium. Hence this system is highly stable, orderly, and predictable. Simple mechanical devices, such as the swinging pendulum of a clock, are classical examples of closed systems in equilibrium.

Constrictive Attractors

An *attractor* is the general pattern of behavior to which a system "settles down," or gravitates. Attractors can be classified as *constrictive* or *strange.* The movements of systems far from equilibrium are governed by *strange attractors* (to be explained in a following section). The movements of systems near equilibrium are governed by *constrictive attractors.* These constrictive types of attractors are primarily either *fixed point attractors* or *limit-cycle attractors.* Fixed point attractors act as constraints or constrictors that settle a system's behavior down to a static equilibrium. For example, the swinging pendulum of a clock eventually settles down, because of friction, to a fixed resting position at the lowest point of its arc (equilibrium). Hence, this attractor is called a *fixed point attractor.* If the pendulum is placed in a vacuum, it does not settle down to a single point but maintains a constant cycle of swinging movement. This new attractor is called a *limit-cycle attractor* because the system's long term or equilibrium behavior is limited to a cyclic or oscillating pattern.

Classroom Example of Near-Equilibrium System

Authoritarian teachers who demand strictly ordered classes are attempting to create *closed near-equilibrium systems.* Like clock work these teachers keep all students on fixed schedules, clearly defined tasks, and daily routines (Marshall, 1995). The task at hand becomes a *fixed point attractor* that these teachers use to constrain, monitor, and regulate students' behavior. Daily routines are *limit-cycle attractors* that are used to establish predictable cycles of behavior and to efficiently manage learning. Any off-task behavior is immediately corrected with the *negative feedback* of warnings and reprimands. This model is very popular among some teachers because the teachers are in total control and everyone knows what is expected of them. There are no surprises or wasted time in these classes. With the exception of the punitive aspects, this closed model of teaching is very consistent with traditional theories of achievement motivation.

Achievement Motivation as a Near-Equilibrium System

Traditionally, achievement motivation has been conceptualized as a strictly ordered, *closed system* (Vallacher & Nowak, p. 11, 1994). For example, achievement motivation is typically portrayed as the initiation, persistence, and directing of behavior toward a predetermined achievement goal. This preset goal acts as a *fixed attractor* toward which

all motivation is constrained and directed. Typically, this motivation is driven by hard work and serious effort. The implication is that effort is directly related to achievement and that the harder students work, the more they will achieve. Any deviation from the goal requires more effort to correct the deviation and to get back on task for goal attainment. This management of effort and work is guided by *negative feedback* which informs students when they are off-task and when they need to work harder to get back on task. The ideal student is a self-regulating robot who automatically works to efficiently stay on schedule for task completion. Spontaneous fun is considered a waste of valuable time or at best a time to recuperate and get ready for more work. Too much fun leads to off-task behavior because it is difficult to control and worse yet it may lead to unbridled chaos in the classroom.

Far-From-Equilibrium Systems

Systems far from equilibrium are open systems primarily governed by *positive feedback* (Chieuw, 1991). In these systems, deviations or fluctuations from equilibrium are amplified by positive feedback loops. These positive feedback loops cause the systems to become unstable, disorderly, and unpredictable. If unchecked by *negative feedback*, these positive feedback loops can create run-away systems that eventually explode and/or crash. These run-away systems will crash when they exceed the carrying capacity of the environment. The population growth of many animals can be described as far-from-equilibrium systems because of their openness to the environment and their exponential growth pattern. If the growth of these populations are unconstrained by negative feedback such as predators, they can become run-away systems that explode with exponential growth. Eventually, the population growth will exceed the carrying capacity of the environment and will crash with a drastic die back of the population.

Generative/Transformative Systems

Not all *far-from-equilibrium systems* are run-away systems. A class of far-from-equilibrium systems, which may be called *generative* or *transformative systems* (Doll, 1993), are able to create a dynamic stability. These systems are generated from the vital interaction of *positive* and *negative feedbacks* (Chieuw, 1991; Keaton, 1995; You, 1993). The delicate ecological balance of predator and prey is created by the interaction of the prey's growth (positive feedback) and the predator's constraint of that growth (negative feedback). However, if the positive

feedback of growth predominates too much over the negative feedback of predation, a run-away system results. If the negative feedback of predation predominates too much over the positive feedback of growth, a collapsing system results. *Generative systems* may be defined as a general class of dynamical systems of which near-equilibrium and run-away systems are merely extreme limiting cases.

Due to our dualistic vision we tend to fixate on these two extreme cases and ignore or confuse the blurry middle. *Generative systems* provide a comprehensive vision of how systems dynamically evolve beyond the extremes. This article proposes that optimal motivation is characterized as a generative system of change that dynamically balances positive and negative feedback.

Strange Attractors

Far-from-equilibrium systems are organized by strange attractors. These attractors exhibit several characteristics: *sensitive dependence, self-similarity (fractal geometry), fractal rhythm, stretching and folding, mixing, and determined chaos* (Chieuw, 1991; Hayles, 1990; You, 1993).

Sensitive dependence on initial conditions means that a small change can lead to unexpected large changes. This is metaphorically know as the "butterfly effect" where the flapping of a butterfly's wings in Rio de Janeiro, Brazil can lead to a rain storm in Houston, Texas.

Self-similarity is a self-embedded pattern that replicates similar but not exact copies of itself across descending scales (levels). In other words, the whole looks similar to each of the parts and each of the parts look similar to the whole. Self-similar patterns across descending scales are called *fractals*. These self-replicating patterns represent a new geometry of uneven shapes with irregular dimensions. By contrast, the traditional Euclidean geometry displays even shapes and regular whole number dimensions. For example, a point has zero dimensions, a line one dimension, a square two dimensions, and a cube three dimensions. However, a fractal has a fractional dimension instead of a whole number dimension. This can be intuitively illustrated by taking a line on a paper and endlessly extending and turning this line--but never crossing itself--to attempt to completely cover the surface of the paper (Bobner, Newman, & Wessinger, pp. 6-7). This twisted (strange) line is neither a one dimensional line nor a two dimensional surface. It has a fractal dimension, the exact dimension depends on how densely it covers the paper, somewhere between one (a line) and two (the paper's surface). This example also illustrates the strange attractor's dual dynamics of

extending (stretching) and turning (folding).

Stretching and folding are the dual dynamics of a strange attractor. Strange attractors fill up fractal space by stretching and folding thin layers of space to create a fold that is then stretched and folded to create another fold and so on (Crutchfield, Farmer, Packer, & Shaw, 1986). This repetitive stretching and folding is an iterative process that creates folds within folds. These folds within folds result in the multi-layered pattern of fractals. This iterative process is similar to the stretching and folding of bread dough or taffy to create a mixed layered effect.

Mixing has been characterized by Rossler as "warring blenders" (In Schaffer, 1984) that vigorously stir space with a repetitive stretching and folding. The mixing effect causes points that were originally close to be stretched far apart and far apart points to be folded close together.

The stretching process has been identified as a type of positive feedback that amplifies deviations from equilibrium (Chieuw, 1991; Keaton, 1995; You, 1993). It has also been identified as a divergent process that moves away from a point of attraction (Chieuw, 1991; Keaton, 1995; You, 1993). This divergent process generates new information that feeds the growth of the system. On the other hand, the folding process has been identified as a negative feedback process that counteracts deviations from equilibrium (Chieuw, 1991; Keaton, 1995; You, 1993). It has also been identified as a convergent process that moves toward a point of attraction (Chieuw, 1991; Keaton, 1995; You, 1993). This convergent process limits new information and constrains the growth of the system.

Fractal rhythm is the temporal rhythm of the mixing, i.e., the rhythmic interaction and sequencing of stretching and folding. A fractal rhythm replicates itself temporally instead of spatially as with fractal geometry. This on-going replication is a recursive process of creating a new beat that is similar but not exactly the same as what preceded it. Because of this ever-shifting variation, the rhythm of a fractal is an irregular beat that is unpredictable. Heartbeats and brain waves exhibit fractal rhythms. These irregular rhythms can be healthy or unhealthy depending on the dimension of the rhythm (Pool, 1989). High dimensional rhythms are generally associated with health whereas low dimensional rhythms are generally associated with sickness. High dimensional rhythms provide a high degree of variability (flexibility) that is very adaptive to unexpected environmental shocks. A drop in dimension implies a drop in variability (flexibility) and hence reduced adaptivity to unexpected shocks.

Furthermore, disruptions of the fractal rhythm of the heart can result in two common pathologies (Briggs & Peat, 1989). In one case, it results in a highly periodic heartbeat that leads to congestive heart failure. Apparently, the repeated firing of the same heart muscles in exactly the same way constricts and fatigues the heart and leads to congestion. This is an example of a constrictive attractor that strangles and drowns itself. In the second case, the disruption results in a highly aperiodic heartbeat that causes the defibrillation of a heart attack. This chaotic heartbeat does not allow sufficient time for the relaxation phase (unbalanced) and the heart is unable to fully recover to continue its frenetic pace. This is an example of a strange attractor that burns itself out because it is unable to relax.

It appears that a sufficiently irregular heartbeat with an adequately balanced firing and relaxation cycle are essential for good health. This dynamically balanced, irregular heartbeat provides the necessary variability to adapt to environmental disruptions. Contrary to popular conceptions, a regular heartbeat is unhealthy because it lacks the flexibility to adjust to disruptions. Perhaps administrators and teachers who demand strictly ordered schools and classes can learn a valuable lesson from the varied rhythms of a healthy heart. Educators need to listen more closely to the pulses of their classes and schools and pay heed to the warning signs of not only extremely chaotic beats but also overly regimented beats. They also need to learn to distinguish between the unhealthy beat of the disruptively chaotic class and the healthy beat of the actively involved class.

Determined chaos or bound chaos results from the dynamic interaction of stretching and folding. This interaction produces a complex global pattern with rich local diversity (Chieuw, p. 71, 1991). The global pattern of a strange attractor is predetermined but its local diversity is unpredictable. The localized chaos of strange attractors drives a wedge between determinism and predictability (Kellert, 1993). It is possible to have global determinism without local predictability. Hence determined chaos makes it possible to have unpredictable free will and creativity in a world governed by strictly deterministic laws (Crutchfield, Farmer, Packard & Shaw, p. 57, 1986).

Classroom Example of Run-Away System and the Strange Attraction of Over-excitement

In the following example, consider how the previously described characteristics of a strange attractor are exhibited by a classroom acting

as a run-away system. A permissive teacher who allows loud noise, unrestricted movement, and frivolous socializing is inviting the disruptive chaos of a *run-away system.* In this chaotic class, students are lured *(attracted)* by the emotional excitement of having fun for fun's sake. Having fun becomes a *strange attractor* that feeds on itself with *positive feedback* as students become more and more excited. Excitement is *sensitive to initial conditions.* A little excitement tends to grow and spread *(stretching)* very rapidly creating a ripple effect *(positive feedback).* One class clown's foolish behavior can easily distract a whole class from learning *(self-similarity between individual student and whole class)* and set off a ripple effect *(positive feedback)* of hyperactivity as students attempt to copy or out do each others' silly antics. Teachers fear the spontaneous excitement of having fun because it is unpredictable (do not know where it is going) and it can easily get out of control *(run-away system).* Teachers are concerned that the hyperactivity of silly pranks and tricks will escalate to the point where children get hurt physically or emotionally. The pain of getting hurt for the victims and the resulting reprimands for the instigators usually crashes the party of a run-away system--the equivalent painful result of a system's heart attack. The abrupt change from over-excitement to pain creates the jagged edge of an unhealthy *fractal experience* where the dynamically balanced beat of excited stretching and relaxed folding temporarily collapses.

The run-away class is consumed by the spreading *(stretching)* of the flames of excitement *(positive feedback).* If the flames of excitement are not dampened *(folding)* by the intervention of the teacher or the self-restraint of the students *(negative feedback),* then the whole class can easily become consumed by its own foolish behavior*(run-away system).* This example of a *strange attractor,* depicted as over-excitement, is a special limiting case of a more general class of strange attractors that will be explained by reversal theory in the following section.

REVERSAL THEORY'S DYNAMICAL SYSTEM OF MOTIVATION

Reversal theory is a comprehensive theory of motivation and personality (Apter, 1982, 1989). This theory can be used to provide a well developed conceptualization of optimal motivation as a dynamical system. According to this theory, motivation is more than the hard work and controlled effort of traditional achievement motivation theories. These theories neglect the spontaneous uncontrolled side of motivation. Reversal theory puts the fun back in motivation. Fun is no longer feared as a cause

of unbridled chaos or relegated to the secondary status of a pleasant diversion but is conceptualized as a fundamental process of achievement motivation. The dynamical nature of motivation can be explained by the bimodal tendency of humans to "reverse" (switch) back and forth between two contrasting motivational modes, the work oriented *telic mode* and the playful *paratelic mode* (Murgatroyd, 1993). The telic mode is a serious minded, goal oriented, anxiety-avoiding mode. In this mode, students anxiously strive to master important work goals so they can relax knowing everything is under control. The paratelic mode is a playful, spontaneous, excitement-seeking mode. In this mode, students enjoy playful experiences that are stimulating and freely chosen. They enjoy these exciting activities so much that they do not want to stop. These two modes are mutually exclusive but complementary. As complements, they account for two primary psychological sources of human motivation. As a system of motivation, the focus is neither on telic work or paratelic play but on the evolving patterns of interaction between these two motivational modes.

An advantage that reversal theory has over other motivation theories is that it acknowledges and accommodates the interaction between both work and play. Traditionally, work and play have been dichotomized as sources of motivation (Good & Brophy, 1994, p. 212). This dichotomy is reflected in the motivational dilemma--described at the beginning of this article--where frivolous play leads to chaotic over-excitement and deadly serious work leads to constricting boredom. According to the conservative tradition of education, motivation is portrayed as "seriousness and hard work." The more liberal tradition portrays motivation as "fun and games." Both traditions in their extreme form are one-sided. Reversal theory proposes that a dynamically balanced interaction between telic work and paratelic play is necessary for optimal motivation. This is not a static balance where work and play are given equal time but a highly varied flexible balance (fractal rhythm) that is both adaptive to and transformative of the environment (Rea, 1993, 1995).

SERIOUS FUN AS A STRANGE ATTRACTOR

Ideally, students should experience a dynamic balance of reversals between the playful paratelic and the serious telic modes. This optimal balance of the two motivational modes is called "serious fun" (Rea,1993, 1995) or "serious play" (Covington, 1992; Mann, 1996; Rathunde, 1993; Wasserman, 1990). Serious fun is defined as play (paratelic) with a

purpose (telic) (Rea, 1995). The combination of seriousness with fun is optimal because students both want (paratelic) and need (telic) to learn. Consistent with this view, Dewey states, "To be playful and serious at the same time...defines the ideal mental condition" (Dewey, 1933, p. 286). He further explains that when play and work are isolated, "... Play degenerates into fooling, and work into drudgery" (Dewey, 1933, pp. 284-285). On the one hand, unbridled play leads to chaotic disorder, and on the other hand, uninspired work leads to stagnant order. However, when they are united, as with serious fun, a complex order is created where education and entertainment become genuine "edutainment" (Armstrong, Cuneo, & Yang, 1994; Rea, 1995, pp. 34-35).

Serious fun invites and encourages the formation of a complex dynamical order. This enriching order resolves the classroom dilemma of stagnant order versus chaotic disorder. Furthermore, serious fun represents a comprehensive class of *strange attractors* of which the extremes of "deadly serious" motivation (stagnant order) and "totally fun" motivation (chaotic disorder) are merely special limiting cases. For this general class of strange attractors, fun performs a *stretching function* that amplifies and spreads excitement, while seriousness performs a *folding function* that controls and calms anxiety. The dynamics of seriousness fun are governed by the stretching of paratelic excitement and the folding of telic relaxation. For example, as children playfully stretch out their minds to take in new information and new challenges, they eventually reach a saturation point. At this point they need to retreat to a safe relaxing space where they can begin the careful folding process of digesting this new information and mastering the new challenges. Eventually, the new information becomes familiar and the challenges are mastered--hence satiation occurs--and the playful stretching of their curiosity begins again to seek new information. The interactive balance of playful stretching and careful folding optimizes the seeking of new information. Like a child's hand that playfully reaches out to a novel object (stretching) and then carefully grasps it (folding)--so is new information processed.

The *mixing* of serious fun leads to a complex fractal layering of motivation that is *self-similar across scales*. Ideally, serious fun is replicated and simultaneously experienced at the multi-levels of the school, the class, and the individual. At the school level, the way the principal motivates teachers is reflected in the way teachers motivate students and this in turn is reflected in the way that students motivate themselves. Serious fun works best with a participatory style of

leadership that permits two-way communication at all levels. This two-way communication allows serious fun to spread from both top down and bottom up.

Contrast this participatory leadership with the one-way communication of authoritarian leadership-- "do it my way or else." This rigid style of leadership results in restrictive schools and classrooms that stifle motivation (Rea, 1995; Iannone, 1995, p. 546). Just as harmful for motivation is a permissive style of leadership that leads to chaotic disorder (Rea, 1995; Iannone, 1995, p. 546). Participatory leadership offers a viable alternative to the false dilemma of authoritarian order versus permissive disorder (Rea, 1995; Iannone, 1995, p. 546). Furthermore, it provides an enriching *mix* of serious fun to motivate students, teachers, and principals (Rea, 1995).

The *mixing* of serious fun also leads to a *fractal multi-rhythm* that is highly varied yet structured. This varied rhythm makes serious fun both stimulating and soothing. The rich polyrhythms of serious fun provide an ever-changing dance beat that energizes and sustains students and teachers in the shared experience of learning (see section on fractal rhythms). When these polyrhythms are divided, the regimented march beat of seriousness soon leads to drudgery and dropout (see description of strictly ordered class) while the frenzied beat of fun rapidly leads to over-excitement and burnout (see description of chaotic class). Furthermore, when the monotonous beat of seriousness and the frenzied beat of fun are forced together, they produce a fractal rhythm that is jarring for both teachers and students. For example, in a strictly ordered class with a highly predictable routine, many students soon depart from the imposed marching orders and seek a more exciting rhythm of fun diversions. When deadly serious teachers notice this fun seeking departure, they immediately attempt to get the off-beat students back in line with a lock-step marching routine. This clash of rhythms results in a power struggle where the students think that the teachers are trying to take away their fun and the teachers think the students do not take the lesson or them seriously (Rea, 1995). This scenario of the classroom is also consistent with research on heart rhythms that reveals, "The healthy heart dances, while the dying organ can barely march" (Browne, 1989; Doll, 1989, pp. 66-67). Just as the healthy heart dances, the healthy class also dances to a dynamic beat that is varied enough to prevent boredom and flexible enough to adapt and transform disruptions.

As an alternative to the previously described power struggle, consider the dynamically balanced rhythm of how the following caretaker

helps an infant to learn about the world. Researchers find that an infant's exciting paratelic exploration of the environment *(stretching)* is ideally alternated with safe periods of telic relaxation *(folding)* with a primary caretaker (Bowlby, 1977; Van der Molen, 1985). This relaxation allows an infant the necessary time to digest new experiences before venturing forth again. If the primary caretaker does not provide sufficient reassurance and relaxation, digestion of the new experiences *(folding)* may not take place and the infant can develop anxiety about exploring *(stretching)* the environment.

This example of interactive balance provides a prototypical model for talent development. Administrators, teachers, and parents can paratelically "challenge" students to take creative risks and give them the freedom to explore their talent related interests *(playful stretching)*. They also need to provide a safe and secure learning environment that "supports" the relaxed telic mastery of new experiences and allows students the opportunity to learn from their mistakes *(careful folding)* rather than fear failure. From this vital combination of support and challenge emerges a learning environment that is neither strictly determined nor overly chaotic. This enriched environment is a *determined* or *ordered chaos* that allows students freedom within structure and fun within limits (Chieuw, p. 71, 1991; Crutchfield, Farmer, Packard & Shaw, p. 57, 1986).

The meaning of providing "challenge" and "support" for serious fun is often misunderstood. To challenge students does not mean to impose unrealistic demands or to force students to do excessive quantities of monotonous work. It means to entrust and empower students to take charge of their own learning and to pursue their own interests. To support students does not mean to give easy assignments or to do the work for them. It means to create a safe environment where students can learn from their mistakes and teachers and administrators becomes guides rather than judges.

CONCLUSION

According to Doll (1993), the theory of complex dynamical systems provides "...the beginning of a new cosmology--one...playful and serious" (Doll,1993, p. 98). This paper further proposes that serious fun (serious play) is a strange attractor that educators can use to both foster and create a dynamical order in the classroom. Hence, serious fun provides an

emergent alternative to the motivational power struggles and dilemmas of overly ordered and disordered classrooms. This emergent alternative is found at the edge of chaos. It is an ever shifting edge of constant change. If our educational system is to continue to evolve, it must learn to adapt to this leading edge of chaos--where new opportunities for growth are generated (Kaufman, 1991).

Although confronting chaos is necessary for creative growth, it requires an appropriate conceptual perspective because it is a two-edged sword that can either destroy or create. It can be experienced as a "battle zone" where bored students actively resist the rigid matching orders of an outdated educational system, or it can be enjoyed as a "performing theater" where principals, teachers, and students dare to dance to the rich polyrhythms of serious fun. In this theater, "Order and chaos intertwine in a complex, ever-changing dance..." (Waldrop, 1992, p. 230) that motivates learning to adapt in a constantly changing world.

To assist educators in learning how to dance on the edge of chaos, three practical recommendations are summarized. Firstly, use a participatory style of leadership that encourages two-way communication and provides support and challenge for everyone (Rea, 1995). This style of leadership affirms and accepts the input of all levels. The values and practices of the whole school become reflected in individual classes, and in turn the values and practices of individual classes become reflected in the whole school. This inter-reflection of levels emerges from an on-going open dialogue among students, teachers, administrators, and all concerned parties. Furthermore, this leadership is empowering because it leads by example and encourages a mutual ownership of learning and teaching. It is also motivating because everyone is challenged to do quality work and is provided with the personal support necessary to achieve challenges. This support and challenge create a safe environment where all participants feel safe to explore their talent related interests and to learn from their mistakes.

Secondly, embrace chaos and trust in the emergent process of creative change (Iannone, 1995). Be open to "motivational moments" that appear in the guise of distractions, digressions, and even disruptions. These perturbations are signs of opportunities to expand the ways that we can learn and teach. They allow the emergence of the fun side of motivation and the freedom necessary for new insights. For example, instead of letting the excitement of the first snow fall of the year disrupt learning--a teacher takes students to the back window and gives an impromptu lesson on how our soldiers during the Revolutionary War had to

camp outside in the snow. Rather than competing with students' interests, the teacher captures the motivational moment and turns their spontaneous excitement into a lasting lesson.

Thirdly, motivate learning with serious fun (Covington, 1992; Mann, 1996; Rea, 1993, 1995; Rathunde, 1993; Wasserman, 1990). Show students how learning can be both seriously important and spontaneously fun. Highlight the fun aspect of serious learning by using art, song, music, movement, drama, games, simulations, fantasy, peer interaction, and hands-on activities. Invite serious learning with open-ended, fun activities that allow the chance to explore and make creative discoveries, inventions, and designs. Fuel the fire of students' interests. Help students to see how their personal interests relate to society's interests and how society's interests are relevant to their personal interests. Provide students with gradual opportunities to learn how to act responsibly and to have fun at the same time. Provide the structure and guidance necessary to help students to channel fun in productive directions.

The complexly ordered system of dynamical motivation encompasses and goes beyond the strictly ordered system of traditional motivation. Achievement motivation no longer need be defined as all hard work and serious effort. Serious fun, when creatively administered, puts the fun back in motivation and makes learning a lot more exciting for everyone.

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